STEEL CONSTRUCTION
Design for reuse and adaptive reuse

Steel for Life and the British Constructional Steelwork Association (BCSA) are working closely together to promote the effective use of structural steelwork. This collaborative effort ensures that advances in the knowledge of the constructional use of steel are shared with construction professionals.

Steel is, by a considerable margin, the most popular framing material for multi-storey buildings in the UK and has a long track record of delivering high quality and cost-effective structures with proven sustainability benefits. Steel can be naturally recycled and reused continuously, and offers a wide range of additional advantages such as health and safety benefits, speed of construction, quality, efficiency, innovation, offsite manufacture and service and support.

The steel sector is renowned for keeping specifiers abreast of the latest advances in areas such as fire protection of structural steelwork and achieving buildings with the highest sustainability ratings. Recent publications have provided detailed guidance on Fire Protection and CE Marking and what it means for the construction sector. Guidance is provided on all relevant technical developments as quickly as is possible.

The sector's go to resource website – *www.steelconstruction.info* – is a free online encyclopedia for UK construction that shares a wealth of up-to-date, reliable information with the construction industry in one easily accessible place.

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Introduction
by Dr Michael Sansom, Director of Sustainability
British Constructional Steelwork Association

Design for reuse and adaptive reuse

Constructional steelwork has always been appreciated for its ability to be recycled at end-of-life. What is increasingly coming into vogue is the ability to reuse structural steel frames in situ, as an alternative to demolition and new build or, when refurbishment is not possible or viable, to reclaim the steel members for reuse in other structures. It is this dual ability to reuse both steel structures and reclaim and reuse structural steel members that sets steel apart from other structural technologies.

Anecdotal evidence suggests that lightweight steel-framed buildings are more likely to be retained, refurbished and extended. Their inherent flexibility and the ability to reconfigure, strengthen and extend steel structures easily all contribute to this. Steel is also routinely used to extend the life of less flexible, heavier concrete structures by the addition of extra floors.

Furthermore, despite the push for shorter spans to reduce upfront embodied carbon, there is growing evidence that longer-span frames with open, column-free space offer greater flexibility and opportunity for retention, reconfiguration and reuse. Extending building lifetimes through creative refurbishment yields far greater economic and environmental benefits compared to the additional upfront expense to facilitate this greater longevity. Better circular economy metrics are needed to prove these benefits to clients and their design teams.

In a subdued market, refurbishment continues to buck the trend with growth of 15% in the private, non-residential sector over the past three years. Steel reuse has a key role to play to help facilitate the growing refurb market.

This publication provides guidance on some of the key issues that can be faced when structural steel is being reused and highlights real life examples of how architects and engineers have overcome challenges to inject new life into existing steel-framed buildings; delivering commercial and environmental benefits.

The steel sector has been at the forefront of the circular economy and reuse agendas for many years and has developed unrivalled guidance and standards on steel reclamation and reuse. Guidance and practice developed in the UK is world-leading and is being adopted within Europe and internationally.

Construction teams are playing a key role in developing new and innovative reuse approaches, as we see in the recent projects in this document. Early engagement with steelwork contractors has always been urged upon clients as a key to ensure efficient, sustainable steelwork designs are realised. Reusing steel requires additional close collaboration with reclamation and deconstruction experts, such as those showcased here.

We hope you find this publication interesting and it will perhaps encourage you to learn more about the benefits of reusing steel and consider it on your next project. The steel sector has a wealth of information on this and related areas that we will be delighted to share, so please do not hesitate to get in touch with us.

April 2026

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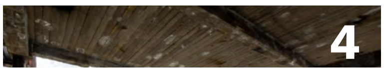
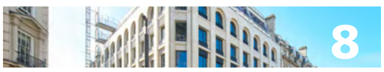





Decarbonisation drive brings focus on reuse of steel

Steel buildings can be retained, refurbished and accommodate new extensions with minimal interventions.

Constructional steelwork has always been an eminently recyclable material, able to confidently claim that no used steel will ever deliberately be sent to landfill. It can be recycled and without any diminution in its unique mechanical properties.

The circular economy and decarbonisation are now key construction industry drivers, with the reuse of steel contributing to both. It has shown itself capable of overcoming any previous reluctance on behalf of designers or their clients to adopt reuse and adaptive reuse strategies. Worries about risk management implications of reusing steel have been overcome by research and practices, and on-site real world experience.

Reuse – a fundamental design principle

Reuse could be on the verge of becoming a fundamental design principle, some engineers say. A realisation is spreading that reducing demand through reuse is a crucial sustainability strategy. Simply recycling steel is no longer enough. The realisation is growing that more proactive efforts to reuse existing materials with minimal post-processing will be needed to tackle the climate crisis.

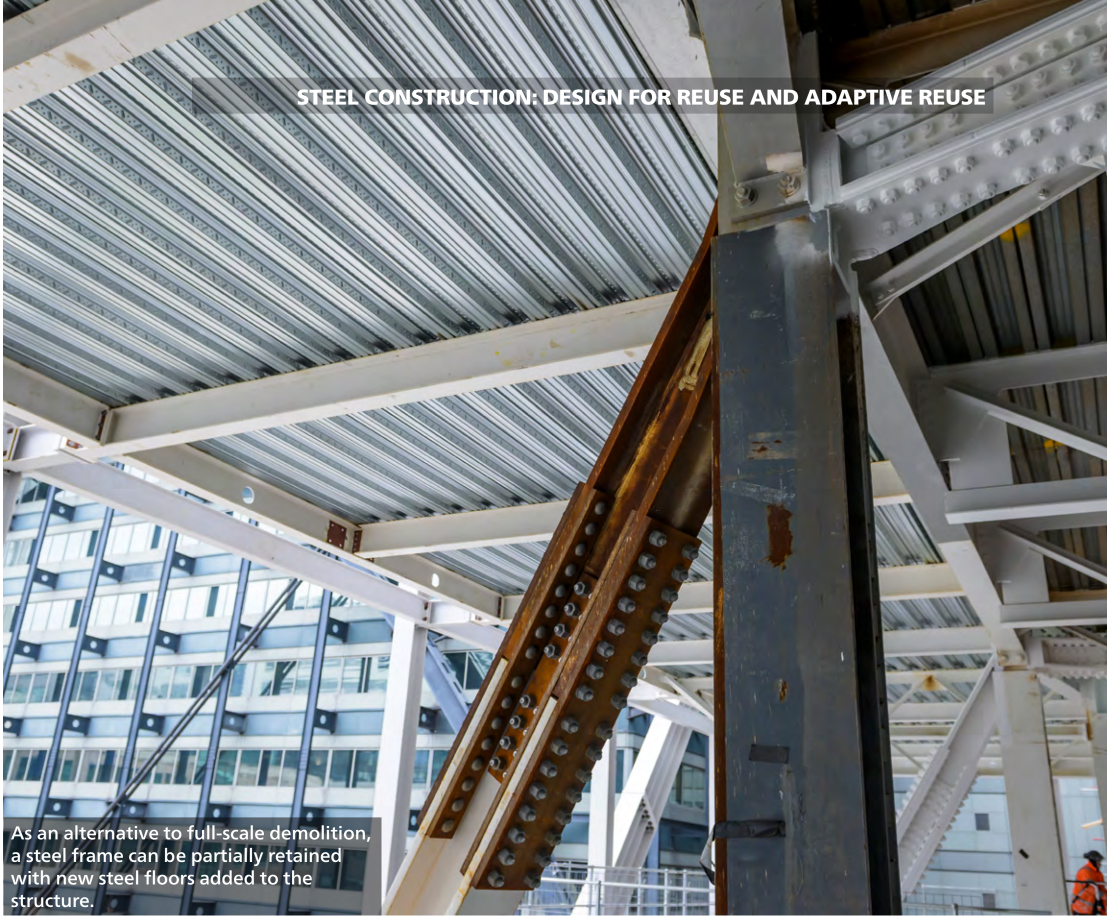
Fortunately steel has flexibility and circular economy benefits that mean it is easy for it to contribute to the decarbonisation ambitions of developers, planners and designers.

Designers are now looking at their practices to ask if there is more that they should be doing in their engineering and architectural approaches to promote the reuse of steel. Examples abound of projects where steel is being reused, either left in situ or taken away to be used structurally elsewhere. Attention is increasingly focused on whether the original design of new structures, or of new ones incorporating reused steel, can contribute to making reuse even easier.

The market is being advised by the steel sector and designers on how to reuse steel from donor buildings that are earmarked for demolition. Collaboration between clients, designers, steelwork contractors, steel manufacturers and the wider construction industry is growing as the drive towards decarbonisation gathers pace. There is still a way to go, however, before the full potential of this approach is realised. Early engagement of steelwork contractors has been consistently urged upon clients by the steel sector as a key to ensuring that the most efficient, low carbon design is adopted, and will be key to decarbonisation strategies.

Circular economy principles and reuse

Key circular economy principles include recycling materials; steel has always been recycled without degradation of its properties, unlike alternative materials



As an alternative to full-scale demolition, a steel frame can be partially retained with new steel floors added to the structure.

that are traditionally only capable of being downcycled in uses far inferior to their originally designed purpose.

The steel sector is helping to educate the supply chain in the best ways to promote sustainable design by specifying the most appropriate materials. This might mean using initially more expensive high strength materials, enabling smaller steel sections to be used, which gives significant carbon savings and cost benefits.

Or it might mean specifying the reuse of steel that has proven its performance abilities in use. Steel reuse is increasingly acknowledged as offering a viable, cost-effective, and sustainable alternative to traditional recycling methods.

Early issues that arose with reuse included establishing any technical limitations on which materials can be reused, the design life of the reused steel in its new application and achieving certification of the material. In response, guidance has been coming forward on material qualification, certification, and design life considerations for repurposed steel in structures such as buildings and bridges. Rigorous material testing procedures confirm the geometry, condition, and structural integrity of reclaimed steel, removing any risk management worries that may have arisen in the early days of reuse.

New techniques have been developed - and older ones redeployed - to deliver assurance that the steel being reused is fully certificated and suitable for its intended new use. Steel has long been known to be able to continue to perform well beyond its original design life, and even beyond its originally intended loadings.

Certification and compliance processes are expected to evolve further, moving towards a more sophisticated testing-based approach.

RIBA Plan of Work

The RIBA Plan of Work, that outlines all stages in the planning, design and building process, from conception to completion on site, reinforces the strategy of designing for reuse, insisting that deconstruction should be factored in from initial concept stages. It urges architects to review the embodied carbon of materials and construction processes in the context of the building's lifespan and operational strategy.

The use of high embodied energy materials is generally to be minimised and low carbon and recycled materials is to be preferred. Inefficient and wasteful use of materials is to be avoided and waste should be designed out where possible. Steel construction supports all of these objectives.

New BREEAM version raises sustainability bar

BREEAM, one of the systems for assessing sustainability in the built environment, launched a new version, V7, in 2025, that aims to raise the sustainability bar further.

The BREEAM V7 update is a response to growing climate challenges, tighter regulations and funders' demands for greater transparency, and scientific advances. The update also takes on board lessons from the real-world experience of the application of previous versions. BREEAM provides a set of criteria (or 'credits') for best practice in sustainable design and provides a credible sustainability label for buildings which, for many developers, has become essential for achieving the highest rental values for their properties.

Increasingly BREEAM certification is essential for achieving planning approval and funding, and it is mandated for many publicly funded projects in the UK. In some areas such as London, BREEAM certification is often insisted on by local authorities for major developments.

BREEAM V7 focusses more than before on a structure's alignment with industry embodied carbon benchmarks.

Net-zero targets now have a stronger focus on whole-life carbon assessments, EU Taxonomy alignment and energy performance, all of which will require advanced solutions, extensive documentation, earlier engagement and greater design collaboration. The steel sector has devoted significant resources over many years to ensure that designers have everything to hand to ensure that requirements like these are no obstacle to designing in steel, whether virgin steel or reused sections are specified.

BREEAM Mat 01 concerns building life cycle assessment; credits are available for undertaking LCA and carbon assessments at the early and detailed design stages and post-completion. Additional credits are available for meeting whole life embodied carbon benchmarks, verifying and publishing data. Minimum standards under Mat 01 are mandated for BREEAM Excellent and Outstanding ratings.

In addition, using reused steel and designing for reuse are rewarded in BREEAM under Mat 05 (Material efficiency), Wst 01 (Construction waste management) and Wst 06 (Disassembly and adaptability). ■

Steel reuse is a commercial success

Completed in 1937, the former D.H Evans department store at 318 Oxford Street is being refurbished and extended into a 34,000m² mixed-use scheme.

Rechristened Elephant, has retail units, restaurants and a gym at lower ground, ground and first floors. Above this, there are modern office spaces on levels two to seven and a penthouse restaurant on the uppermost eighth floor.

The construction programme consisted of two phases, with the initial work involving a traditional cut-and-carve approach to the lower floors. The work included retaining a large proportion of the façade and structure, which significantly reduced the new building's whole-life embodied carbon.

Within the retained structure, new openings for lifts and stairs were created, two double-height entrances for the offices were formed, a new steel-framed core installed and the upper two floors were demolished in readiness for the next stage.

In the second phase, three new floors above the existing structure have been added.

As part of the cut-and-carve and demolition of the original upper floors, ten columns from the fifth-floor were removed and reused as part of the steel frame that forms the new upper levels (some other steelwork was removed and donated to another London scheme; see box below). ■

Elephant, 318 Oxford Street, London

Main client: Publica Properties
Architect: Studio PDP
Main contractor: McLaren Construction
Structural engineer: Civic Engineers
Steelwork contractor: Severfield
Steel tonnage: 1,200t

TBC.London

Main client: FORE Partnership
Architect: ECE Architecture
Main contractor: Willmott Dixon
Structural engineer: Webb Yates Engineers
Steel tonnage: 640t

Incorporating 40t of steelwork sourced from the redevelopment of 318 Oxford Street, TBC.London is an outstanding office development overlooking the River Thames near Tower Bridge.

The uppermost floor of the existing structure was removed and two steel-framed floors were added, with a third additional floor set back from Tower Bridge, creating a new seven-storey office building.

The set-back floor creates one of three rooftop terraces within the scheme. With a total area of just under 900m², all tenants will have access to one of these outdoor spaces.

Much of the uppermost floor has been formed with repurposed steelwork, sourced from Cleveland Steel & Tubes. For the most part, it is surplus stock that had been produced, but never actually used.

One Exchange Square, London

Main client: LaSalle Investment Management
Development manager: M3 Consulting
Architect: Fletcher Priest Architects
Main contractor: Multiplex
Structural engineer: Heyne Tillett Steel
Steelwork contractor: Bourne Steel
Steel tonnage: 1,300t

One Exchange Square in the City of London, a 1980s-built steel-framed office building, is being revamped into a modern 13-storey development.

The completed building will comprise 39,948m² of premium workspace and 1,579m² of ground floor retail, fronting both Bishopsgate and the newly re-landscaped park at Exchange Square.

As 90% of the existing structure is being retained, the building will have 50% lower embodied carbon than a typical new build office of comparable size, saving approximately 7,600 tonnes of CO_2e compared to the GLA 2030 target.

Following a demolition programme, some existing plant levels were demolished, making way for up to four new steel-framed floors to be added to the building.

Before any adaptations to the retained structure could begin, the existing foundations and existing steel frame had to be surveyed. This determined that the piled foundations had sufficient capacity for the proposed scheme, while some areas of the existing steel frame needed to be strengthened with steel plates.

The standout element of the scheme is along the western elevation, where a 7.5m-deep x 42m-long extension, from the second floor up to level 12, includes a four-storey triangular exoskeleton. ■

Timber Square, London

Main client: Landsec
Architect: Bennetts Associates
Main contractor: Mace
Structural engineer: Heyne Tillett Steel
Steelwork contractor: William Hare
Steel tonnage: 2,600t

Targeting the highest sustainability ratings, Timber Square consists of two buildings: a 1950s-built printworks (now simply known as Print), where 80% of the existing structure is being retained and five new floors added, forming a nine-storey office block, and a new build 14-storey office building (known as Ink).

The retained structure in Print is a steel frame supporting in situ concrete floors, while the new levels are built with a hybrid solution of steelwork supporting cross laminated timber (CLT) flooring.

A carbon saving has been generated by using 120t of reused steelwork. This steelwork has been fabricated into approximately 500 beams, used primarily in and around the cores in both buildings.

As Print was originally built for industrial use, a cut and carve construction programme has been undertaken, whereby the retained structure has been extensively remodelled to create a modern office environment. The work required a significant amount of new strengthening steelwork to be erected, providing support and allowing voids to be cut through the concrete floors.

The front elevation which was originally a large loading bay facing Lavington Street, has been adapted to create a double-height ground floor reception area. Above this, a series of seven large steel transfer beams have been installed to support and create a new set-back and terrace at third-floor level.

30 Duke Street St James's is a landmark and sustainable addition to London's West End.

Reused steel drives the circular economy

Helping 30 Duke Street St James's to attain its impressive sustainability credentials, 77% of its structural frame is reused and reclaimed steelwork, making it the largest steel reuse project for a commercial office in the UK to date.

Located in the heart of London's West End, a commercial scheme at 30 Duke Street has led the way in steel reuse.

Replacing two buildings (50 Jermyn Street and French Railways House, which fronted Piccadilly), the new eight-storey development has boosted its sustainability credentials with a steel frame that consists of 77% reclaimed steel.

Obtained from a number of different sources, the largest portion of the reused steel (67% or 375t) was sourced from the demolition of a donor building. Known as City Place House, this is another London scheme within developer GPE's portfolio (see box).

Reclaiming and reusing materials is all about making good use of what is available. With that in mind, a small quantity of steel (3t, which previously formed a plant deck) was also salvaged from the demolition of the concrete-framed French Railways House.

The remainder of the project's steel frame contains material from Cleveland Steel & Tubes and European Metal Recycling's stock of reclaimed steelwork, as well as a quantity of new sections.

While the project team say they were fortunate to have access to a donor building, the scheme has demonstrated that reuse is feasible at any scale.

This is borne out by the fact that the reused and reclaimed steel approach has achieved an impressive embodied carbon saving of 744t CO_2e.

The steel frame for the new building

30 Duke Street St James's, London
Main client: GPE
Architect: Make Architects
Main contractor: Mace
Structural engineer: Elliott Wood
Steelwork contractor: William Hare
Steel tonnage: 559t

Cleveland Steel & Tubes Managing Director Roy Fishwick, says: "While steel reuse is possible in virtually any project, it is important that prominent projects like 30 Duke Street St James's fly the flag and also push the boundaries. This gives the market more awareness and confidence regarding reuse.
"Cleveland was pleased to be involved, as using multiple suppliers gave a better outcome for the project and guaranteed the required stock."

William Hare Project Director Simon Bourne, says: "This project is a brilliant example of how innovation and collaboration can drive meaningful change in the built environment.
"We're proud to have contributed to a scheme that not only redefines sustainable construction, but also delivers tangible carbon savings through the reuse of structural steel."

GPE Executive Director Dan Nicholson, says: "This was a brilliant opportunity for us to create best-in-class office and retail spaces in the heart of St James's.
"Sustainability is at the core of the development, and we are setting a precedent for London by reusing structural steelwork."

Elliott Wood Associate Director Gemima Walker, says: "This project demonstrates the potential of material reuse, with reclaimed steel integrated into the new frame.
"It shows that, with a collaborative team and a clear client vision, the technical challenges of steel reuse can be overcome. Early contractor involvement and flexible procurement enabled us to continue to incorporate reclaimed steel, just months before fabrication."

Mace Senior Project Manager Nicholas Bull, says: "The large-scale reuse of steelwork is not just a sustainability achievement, it demonstrates that reclaimed materials can deliver high-quality, modern buildings while significantly reducing carbon emissions.
"By showing reuse at scale, it paves the way for industry adoption, helping construction transition from a traditional procurement model to a truly circular economy."

starts at ground floor and sits atop a concrete floor slab and a single-storey basement, which has been retained from the previous scheme.

In the completed building, the basement and ground floor will house retail units, while also accommodating the main entrance lobby and reception.

The ground floor is a double-height space throughout, creating plenty of flexibility. This is highlighted by the fact that one retail unit comes replete with a steel-framed mezzanine level.

From the first floor upwards, the building consists entirely of column-free office spaces, with terraces wrapping around the southern elevation on the uppermost three levels.

New and reused steelwork

The new steelwork sections for the project amounted to approximately 54t and were fabricated, supplied and erected by William Hare as part of the overall steelwork package. The company also installed 64t of new bolted connections within the main frame and refabricated all of the reclaimed material, once it had been repurposed.

The layout of the new building was designed around the lengths of the available salvaged steelwork, allowing the team to use the donor building's beams efficiently.

Bespoke openings were also cut into the previously solid beam sections, re-fabricating them into cellular members that accommodate the building services within their depth.

In addition to the many sustainable benefits, the use of steelwork has also allowed the design to create the open-plan office floorplates the client wanted.

This has primarily been achieved by positioning the concrete core, which contains lifts and staircases, in an off-set location along the building's western party wall.

In many commercial buildings, the core is often placed in a central position, but on this project, that would have used up too much valuable floor space.

From the offset core, the steel beams, which span up to 13m-long, radiate outwards to the north, east and south elevations, forming column-free internal areas on every floor.

The long span internal beams support metal decking and a concrete topping, forming a composite flooring solution for every level. ■

Donor building provides reused steel

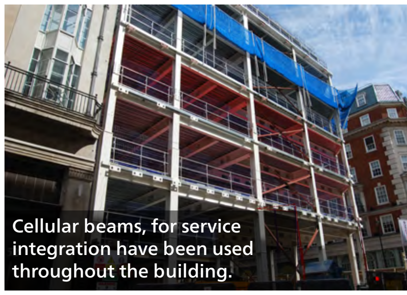
GPE says it is committed to reducing the carbon footprint of its developments and is engaged in reclaiming and reusing steelwork wherever possible. The demolition of the 1990s-built City Place House, located a short distance from London's Moorgate Station, provided 1,500t of salvaged steelwork.

As well as reusing some of this material on the Duke Street St James's project, around 50t was incorporated into the steel frame of 2 Aldermanbury Square (a 13-storey office block built on the site of City Place House) with the remainder being stored for future use.

The existing City Place House steel frame included long-span beams without penetrations, making it an ideal opportunity for reuse.

To facilitate this sustainable and circular economy approach, the demolition process was planned and executed to allow for the steelwork to be removed at maximum length without damage.

William Hare subsequently refabricated the steelwork into trimmers (erected around the main core and risers at 2 Aldermanbury Square), and beams and columns to form a rooftop plant deck.



Cellular beams, for service integration have been used throughout the building.

New steelwork was integrated with reclaimed material.

Salvaged steelwork ready for testing and refabrication.

Maximising a steel frame

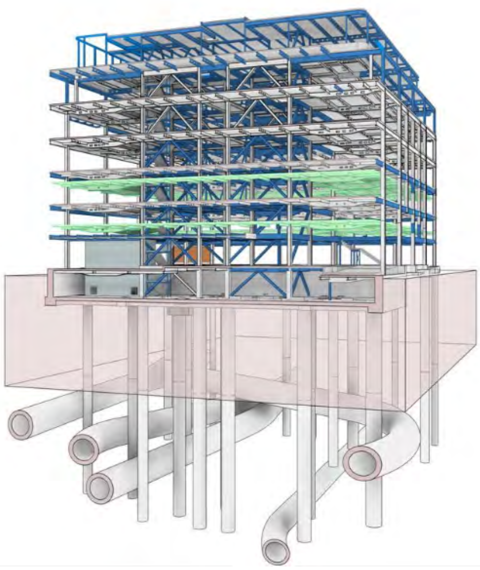
Adaptive reuse of structural steelwork has come to the fore at 20 Giltspur Street in London, where an innovative cut and carve scheme has allowed an extra floor to be accommodated within an existing frame.

Reuse and recycle is the way to go for all sectors of industry as the UK government strives to decarbonise the economy in order to meet its net zero target by 2050.

To achieve this target, business sectors are being encouraged to make better use of existing materials and the construction sector's response has seen it adopt a number of initiatives, in particular retrofitting and refurbishing existing buildings.

This trend is on the rise, partly because planning departments view it as an environmentally friendly improvement on demolition and new build and their associated embodied carbon.

Utilising adaptive reuse (reusing an existing structural frame), a scheme at 20 Giltspur Street in the City of London has pioneered an innovative refurbishment solution that includes reconfiguring two lower floors of a steel frame and then inserting an extra floor.



Below ground, the building is constructed above a section of the Roman Londinium Wall (a scheduled ancient monument) and multiple rail tunnels.

The existing first and second floors within the original building had generous floor-to-ceiling heights (5m-tall), as they once accommodated trading areas. However, there was not quite enough headroom for another floor level without some interesting design and construction work.

The solution involved jacking-up the floors, to heights of 1.5m and 1m respectively, in a procedure that is thought to have been a first in London. In this way, a brand-new first floor has been accommodated within the height of the existing building.

"We specialise in challenging projects and this solution worked on this scheme," says Deconstruct Steelwork Operations Director Stephen Dorer.

"We envisage this approach becoming more common practice in the near future, as the innovation demonstrated has resulted in considerable cost, programme and carbon savings."

According to structural engineer Elliott Wood, the solution came about as it was the best way of maximising and extending the building.

A feasibility study was conducted early in the programme that confirmed the advantages of retaining a large proportion of the existing structure and then refurbishing and enlarging the building. Approximately 80% of the original steel frame and 70% of the concrete frame has been retained, resulting in a considerable carbon saving for the scheme.

Extending the building upwards was not an option as it sits close to St Paul's Cathedral and within the protected viewing corridor. Going down was also not feasible, as there are a number of rail tunnels under the site.

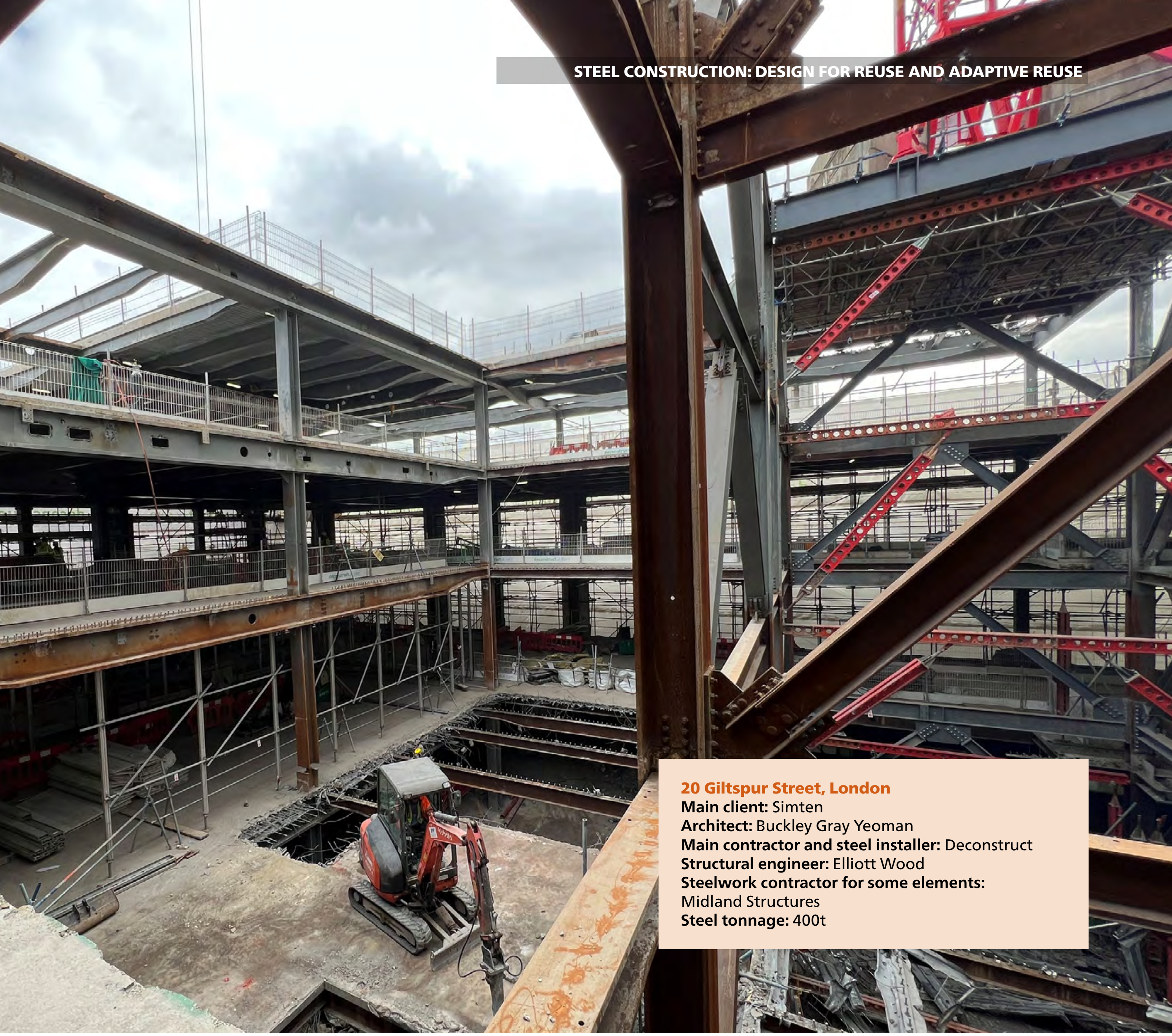
The project has increased the floor area by 40%, without changing the massing.

The site is hemmed in by St Bartholomew's Hospital to the north and a pub to the south, and a street and a courtyard to the west and east. So, making adaptations within the existing footprint was the only option.

A careful design was implemented, whereby new steel-framed elements have been installed, while some areas are demolished. The aim is to balance the structural loads, so as not to overload the existing retained foundations.

The building is formed around a centrally-positioned braced core that provides stability to the steel frame. The core has been reconfigured to form a more efficient design, whereby the stairs and risers have been moved, while other areas are infilled to create more valuable office space.

The reconfiguration of the core has resulted in some of the steel beams and bracing elements being removed. These



20 Giltspur Street, London
Main client: Simten
Architect: Buckley Gray Yeoman
Main contractor and steel installer: Deconstruct
Structural engineer: Elliott Wood
Steelwork contractor for some elements: Midland Structures
Steel tonnage: 400t

sections were sent for repurposing and reuse on another construction job.

Steel that once restrained the façade, which is being replaced, was also removed for reuse.

As well as the transportation infrastructure below the site, another challenging aspect of the development is the fact that a portion of London's Roman wall is located within the building's basement.

It is a scheduled monument and cannot be altered or removed. So, to take advantage of this historical structure, it is being opened up to form an exhibit in the reception area of the completed building.

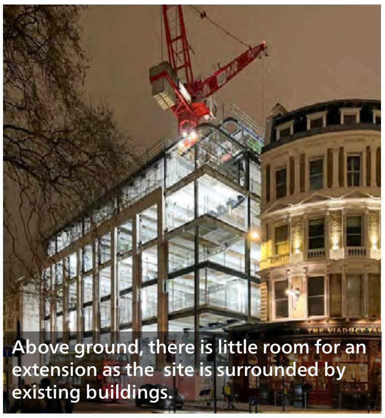
Two new 21m-long plate girders, each weighing 20t, have been installed to create the necessary column-free space over the ancient monument. These large pieces of steelwork also form part of the new steelwork that will support a new first floor, which has been added to the scheme.

To prepare the steel frame for the insertion of the new and extra floor, the process involved propping the existing first and second floor composite slabs, removing the connections between the beams and columns, and then jacking the floors to the required height.

The two floors, which were jacked-up approximately two months apart, required more than 50 lifting points for each floor plate, each needing a double hydraulic jack.

"Each floor plate was slowly raised upwards, around the disconnected columns. It took about one day for each floor to be jacked into its new position, at which point new connections were made between the beams and columns," says Elliott Wood Associate Daniel Bassett.

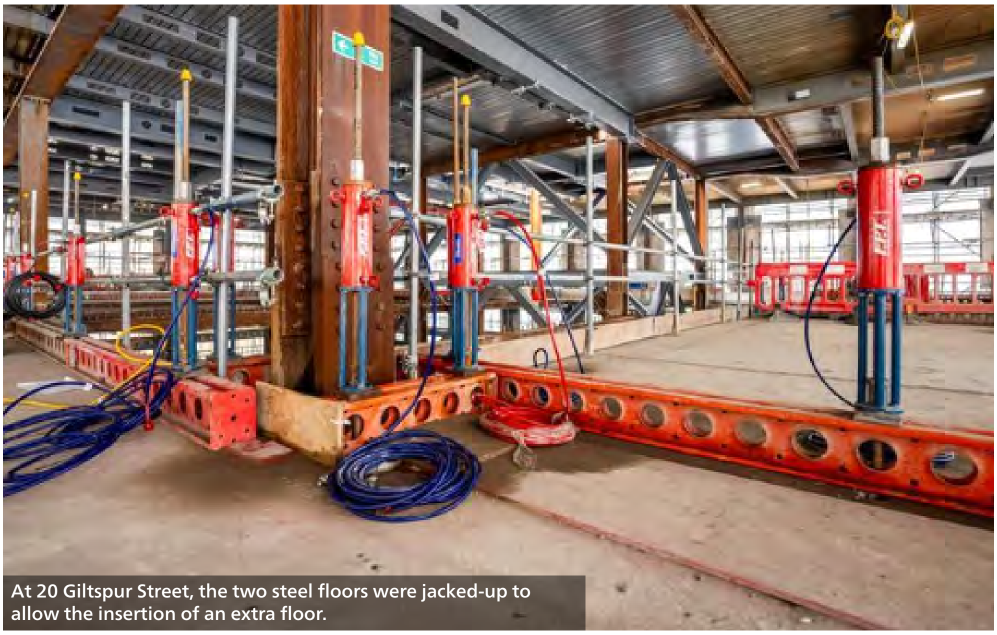
Once completed, the previous first floor became the second in the new scheme, and the current second floor is now the third floor. Above this, three further floors have been retained, on top of which the existing plant room has been demolished and replaced with an enlarged steel-framed structure, completing the seven-storey scheme. ■


Above ground, there is little room for an extension as the site is surrounded by existing buildings.

Reuse of structural steel can be the superior option

Structural steel and steel-framed buildings are inherently reusable and adaptable, which leads to extended building lifetimes. Here we explain that where it is not possible to retain and adapt steel buildings in situ, structural steel members can be deconstructed and reused in new structural applications.

Reuse, adaptation and extension of steel-framed buildings



At 20 Giltspur Street, the two steel floors were jacked-up to allow the insertion of an extra floor.

Steel-framed buildings possess a set of intrinsic characteristics that make them particularly well suited to **adaptation**, **refurbishment**, and **extension** over their life. These advantages stem from both the material properties of steel and the way steel structures are typically designed and constructed.

Long spans and open structural grids

Steel's high strength-to-weight ratio enables **long spans with fewer columns**, creating open and regular floor plates and increasing lettable floor area. This structural openness allows internal layouts to be reconfigured with minimal impact on the primary structure; walls, services, and fit-out can be moved or replaced without major structural intervention.

Clear separation of structure and services

In steel-framed buildings, the primary frame is usually independent of internal partitions and building services. This separation means that changes to mechanical, electrical, and plumbing systems - or upgrades for new uses - can often be accommodated without altering the load-bearing structure.

Ease of structural modification

Steel members can be **strengthened**, **altered**, or **augmented** relatively simply. New beams can be bolted to existing members, openings can be formed, and additional loads can be accommodated through local reinforcement rather than wholesale reconstruction. This makes it practical to adapt buildings for new occupancies or higher performance requirements.

Straightforward vertical and horizontal extensions

Steel frames are inherently well suited to adding **extra storeys or lateral extensions**. Their comparatively low self-weight reduces the impact on existing foundations, and new steelwork can often be connected directly to the existing frame. This allows buildings to grow incrementally in response to changing needs.

Reversible and demountable connections

The widespread use of **bolted connections** allows steel structures to be partially dismantled and reconfigured. Elements can be removed, relocated, or replaced with limited disruption - an important advantage in live or occupied buildings.

Predictable behaviour and re-analysis

Steel's uniform and predictable structural behaviour allows engineers to **re-analyse existing frames** for new loading conditions. This predictability reduces uncertainty when adapting buildings, lowering both technical risk and cost.

Alignment with circular economy principles

Because steel frames can be modified, extended, and even partially reused, steel-framed buildings lend themselves to **longer life cycles**. Adaptation in situ avoids demolition, preserves embodied carbon, and supports building longevity.

Originally built in the 1990s, the steel-framed YY London scheme in Canary Wharf has been reconfigured with the addition of three office floors.

Reuse of deconstructed structural steel members

Structural steel has a unique, inherent capacity for deconstruction and **direct reuse** at the elemental level that distinguishes it from most other primary construction materials. This capability arises from a combination of material properties, structural behaviour, and established construction practices.

Material durability and performance retention

Structural steel does not degrade significantly with age when properly protected. Its mechanical properties (strength, stiffness, and ductility) are intrinsic to the material and remain essentially unchanged over time. Unlike concrete, steel does not suffer irreversible chemical changes that prevent reuse, allowing members to be redeployed with confidence once inspected and verified.

Standardisation and predictability

Steel construction relies on highly standardised section sizes, grades, and design rules. Universal beams, columns, and hollow sections are produced to consistent specifications, making them inherently compatible with new designs. This standardisation means reclaimed steel elements can often be reassessed, re-certified, and integrated into new structures with minimal re-processing.

Demountable construction methods

Steel frames are typically assembled using **bolted connections**, which are reversible by design. Buildings can therefore be dismantled rather than demolished, enabling beams and columns to be recovered intact. This contrasts with many composite or monolithic systems where separation of elements is difficult or impossible without destruction.

Design adaptability and structural versatility

Steel's high strength-to-weight ratio and predictable elastic behaviour allow reused members to be re-analysed for new loading regimes. Sections originally designed for one building type can often be repurposed for others - sometimes with minor modification - without compromising safety or performance.

Circular economy and carbon benefits

Direct reuse preserves the full embodied value of steel, avoiding emissions from remelting and re-rolling. This makes reuse the highest-value circular pathway for steel, which can deliver greater carbon savings than recycling alone, while also reducing demand for virgin material extraction and processing.

Compatibility with modern verification and digital tools

Advances in non-destructive testing, material traceability, and digital design tools (e.g. BIM, product passports and structural re-analysis software) further strengthen steel's reusability. These tools make it increasingly feasible to verify existing members, document their properties, and confidently redeploy them in new projects.

Design for deconstruction and reuse

Bolted connections allow easier disassembly of a steel frame.

Structural steel is inherently well placed for reuse, but specific **design**, **specification**, **and construction choices** can significantly increase how easily frames can be dismantled and redeployed at the end of a building's life; or adapted during it.

Design for disassembly from the outset

The most important step is intentionality. Frames should be conceived as **assemblies of components**, not permanent monolithic structures. This means:

- Clear load paths that remain understandable over time
- Avoiding hidden or inaccessible structural elements
- Designing members so they can be removed without destabilising large parts of the frame

Early decisions at the concept stage have the biggest influence on future reuse potential.

Prefer bolted over welded site connections

Bolted connections are inherently reversible, whereas site welding permanently fuses elements together.

- Use **bolted beam-to-column connections** as the default
- Minimise site welding to non-structural or secondary elements
- Where welding is unavoidable, confine it to easily separable sub-assemblies

This allows frames to be dismantled in a controlled sequence rather than cut apart.

Use standardised sections, grids, and details

Reuse is far easier when components are standardised and interchangeable.

- Standard section sizes and steel grades
- Regular structural grids and storey heights
- Repetition of connection details across the building

Standardisation increases the likelihood that reclaimed members will suit future projects with minimal modification.

Avoid composite action where possible (or make it reversible)

Composite slabs and encased steel can severely limit reuse.

- Use **bolted, demountable shear connectors** where feasible
- Consider dry floor systems, CLT, or precast units supported on steel

Reducing permanent bonding between materials preserves the steel's reusability.

Make connections and members accessible

Steel can only be reused if it can be safely inspected and dismantled.

- Keep critical connections visible or accessible
- Avoid burying steel in finishes, fire protection, or concrete where alternatives exist
- Use removable fire protection systems (e.g. boards rather than sprayed coatings)

Accessibility reduces damage during removal and improves confidence in reuse.

Design for potential future load changes

Slightly higher initial capacity can enable reuse in more demanding future applications.

- Use conservative utilisation ratios for primary members
- Design columns and beams to accommodate potential vertical extensions
- Allow for future service penetrations without cutting main members

This 'headroom' can significantly extend the usable life of steel buildings.

Document material properties and connection logic

Future reuse depends on knowledge.

- Retain mill certificates and material grades
- Record connection types, bolt grades, and design assumptions
- Maintain as-built drawings and digital models

A well-documented frame is far more likely to be reused than one with unknown provenance and avoids the need for costly sampling and testing.

Integrate digital tools and material passports

Digitalisation supports reuse at scale.

- BIM models linked to member properties
- Unique IDs for beams and columns
- Material passports recording dimensions, grade, and service history

This transforms steel frames into **traceable material assets**, so steel would be recycled and not be waste.

Plan dismantling, not demolition

End-of-life thinking should be embedded up front.

- Define dismantling sequences in design documentation
- Ensure lifting points and access routes exist
- Specify tolerances and protection methods for removal

This reduces damage and cost when the structure is eventually taken apart.

Guidance and standards on the reuse of structural steel

Reuse of structural steel is mostly addressed through a mix of:

- **Practical industry protocols/guides** (how to assess, test, and specify reclaimed members), and
- **Existing design and execution standards** (Eurocodes for design; EN 1090 for execution), with **newer Europe-wide reuse provisions** now emerging to plug the gaps.

UK guidance and practice (most established)

SCI Protocol for Reusing Steel (the core UK technical playbook)

The Steel Construction Institute's (SCI) publication P427 (*Structural Steel Reuse 2nd edition*) and a supplementary guide P440 (*Reuse of pre-1970 steelwork*) set out a structured process for: information capture, inspection, tolerances, testing (including approaches for determining material properties), and designer recommendations so reclaimed members can be reused with confidence.

BCSA specification route (making reuse 'procurable')

BCSA provides a *Model specification for the purchase of reclaimed steel sections*, intended to be used alongside the NSSS. This helps clients/specifiers translate "we want reused steel" into contractual requirements (e.g., documentation, responsibilities, and acceptance criteria).

IStructE guidance (designer-focused, circular-economy framing)

IStructE's circular economy/reuse guidance includes specific content on steel reuse and the decision pathways (e.g., reuse in situ vs reclaimed member reuse), aimed at supporting designers to select appropriate reuse strategies and manage associated verification issues.

European standards and guidance (rapidly developing)

The key new European document: CEN/TS 1090-201

This provides **complementary provisions to EN 1090-2** for using reclaimed structural components, including scope/limitations (notably focused on typical building execution classes and quasi-static loading; fatigue is explicitly constrained).

How it connects to the existing 'main' standards

- **Structural design** relies on **Eurocode 3 (EN 1993 series)**; reclaimed members are re-verified to the same safety intent, but with additional attention to uncertainty in properties, condition, and tolerances.
- **Execution/quality** is anchored in **EN 1090-2** and **CEN/TS 1090-201**, with the reuse technical specification effectively adding reuse-specific requirements on top.

European research-led design guidance feeding standardisation

European programmes (e.g., PROGRESS and related outputs) have produced designer-oriented recommendations on designing for future reuse and on using reclaimed elements, including traceability, assessment, and practical enablers/barriers.

EU JRC guidance on European rules for reused steel (policy/technical bridge)

The European Commission's Joint Research Centre has published a review aimed at establishing consistent European approaches for designing with reclaimed steel components in line with Eurocodes, highlighting key issues and needed actions.

Common requirements across UK and Europe

Across the main documents, the recurring expectations are broadly consistent:

- **Traceability and records**: what the steel is, where it came from, what's been done to it, and how it's identified.
- **Condition assessment**: damage, corrosion, straightness, holes/cut-outs, and geometry/tolerances.
- **Material property verification**: routes to establish grade/strength/weldability where original documentation is missing (using proportionate testing).
- **Execution QA**: ensuring reclaimed components are processed/fabricated/handled under appropriate execution controls (the EN 1090 framework, with reuse add-ons).
- **Clear roles and liability allocation**: who is responsible for investigation, testing, declaration/specification, fabrication, and acceptance. ■


New steelwork can be bolted to existing steel frames to create new floorplates.

Design for reuse
Summary of key points

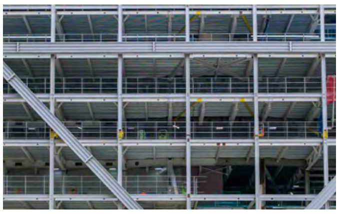
Constructional steelwork is inherently recyclable, boosting the circular economy.

Existing steel-framed buildings are reusable, as minimal interventions can allow extra floors to be added to the structure.

Steelwork can easily be disassembled from one project, refabricated and then reused on another scheme.

Steel reuse is acknowledged as a viable, cost-effective and sustainable alternative to traditional recycling methods.

Allowing for better reuse of steelwork, certification and compliance processes are expected to evolve in the near future.



Bringing reuse and recycling into stronger focus, BREEAM has launched version (7), which aims to raise the sustainability bar.

Photo: APHITHANA/Shutterstock

By retaining and reusing an existing steel frame, a project can significantly lower its embodied carbon.

Planning departments view reusing existing steel frames as an environmentally friendly alternative to demolition programmes.

Reconfiguring an existing steel frame structure can be efficiently and economically achieved with minimal steel strengthening works.

To make steel structures easier to disassemble for reuse in the future, structures should be constructed using accessible bolted connections.

Reuse is far easier when components consist of standard section sizes and steel grades.

There is a wealth of published industry guidance on the reuse of steelwork.

Steel for Life

Steel for Life is a wholly owned subsidiary of BCSA, created in 2016, with funding provided by sponsors from the whole steel supply chain. The main purpose of Steel for Life is to communicate the advantages that steel offers to the construction sector. By working together as an integrated supply chain for the delivery of steel-framed solutions, the constructional steelwork sector will continue to innovate, educate specifiers and clients on the efficient use of steel, and market the significant benefits of steel in construction.

British Constructional Steelwork Association

BCSA is the national organisation for the steel construction industry: its Member companies undertake the design, fabrication and erection of steelwork for all forms of construction in building and civil engineering. Industry Members are those principal companies involved in the direct supply to all or some Members of components, materials or products. Stakeholder Members are clients, professional offices, educational establishments etc which support the development of national specifications, quality, fabrication and erection techniques, overall industry efficiency and good practice.

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